INTERSCAPULOTHORACIC AMPUTATION.

REPORT OF OPERATION FOR SARCOMA OF THE HUMERUS.

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The following case is interesting because of the great rapidity of the growth of the disease, the associated pain, the technique of the operation, and the complete absence of surgical shock, the successful immediate result and the disappointing ultimate result, certain pathological conditions in the specimen, and the excellent X-ray plates of the tumor.

The patient was a young adult, a member of the fire department in Wakefield, Massachusetts, with an unimportant family history and an entirely negative previous personal history. It is noteworthy that only eight weeks before the operation did this more than ordinarily intelligent man notice anything wrong with his arm. At that time his arm began to feel weak, and he could not raise the elbow from the side without pain in the shoulder. He thought there was "crackling" in the joint when he first began to notice the weakness and pain. He was treated for two weeks by a Wakefield physician and then came to the Out-Patient Department of the Massachusetts General Hospital, where a diagnosis of muscular rheumatism, or bursitis, was made, and massage and hot and cold douching ordered without any relief. Four weeks before operation, enlargement of the shoulder was first noticed by him.

The patient entered the South Surgical Service of the Massachusetts General Hospital on October 23, 1903. Through the kindness of Dr. Beach, the senior surgeon of the service, the writer, his assistant surgeon, was allowed to take charge of the case and to operate.

Upon examination, the patient was found to be a well-developed and nourished young man, apparently in perfect general physical condition. There was a distinct tumor mass at the point of the left shoulder, evidently arising from the humerus, somewhat tender, about as large as a man's fist, and somewhat fusiform in shape with undefined margins. There was almost complete loss of motion in the shoulder-joint, no glands could be palpated in the axilla. The pain from the growth was undeniably severe at all times. An X-ray photograph (Fig. 1), in fact more than one, was taken, and, although the plates showed almost beyond question a periosteal sarcoma of the humerus, the fact that the only operation to be considered was the very severe one involving the removal of the entire upper extremity, made an exploratory incision, to obtain a piece of the growth for microscopic examination, seem wise. All the surgeons who saw this case in consultation agreed in advising this; the patient himself refused operation until this proof was shown him. On the 28th of October, under ether anæsthesia, an incision three inches long over the tumor mass, parallel to the fibres of the deltoid muscle, was made, and it was found that the muscle was involved in the growth. Microscopic examination of the pieces of tissue removed showed undoubted giant-celled sarcoma.

A sharp reaction in temperature and pulse followed this diagnostic incision. The patient's temperature rose to 103° F. forty-eight hours after the operation, and his pulse to 120, and there was greatly increased pain in the shoulder, which extended down the arm into the hand. The increase in pain was very marked; for three days the patient was in great distress and looked very sick, after which the temperature and pulse came down to approximately normal, and the pain diminished to what it had been previous to the exploratory incision. There was no evidence of septic infection in the incision at this time or afterwards to account for the reaction. The wound healed by first intention. It was a matter of interest and speculation as to whether the reaction was not due to forcing into the circulation chemical products of the sarcomatous tissue, and possibly sarcomatous cells. The importance of not cutting directly into a malignant growth, and that in operations for the removal of carcinoma and sarcoma all cutting instruments should be kept away from the diseased areas to avoid metastasis directly caused by the surgeon himself, has long been recognized theoretically. In this case the exploratory incision could have, and possibly may have, caused metastasis and recurrence. This point will be taken up later when the pathological conditions found in the specimen

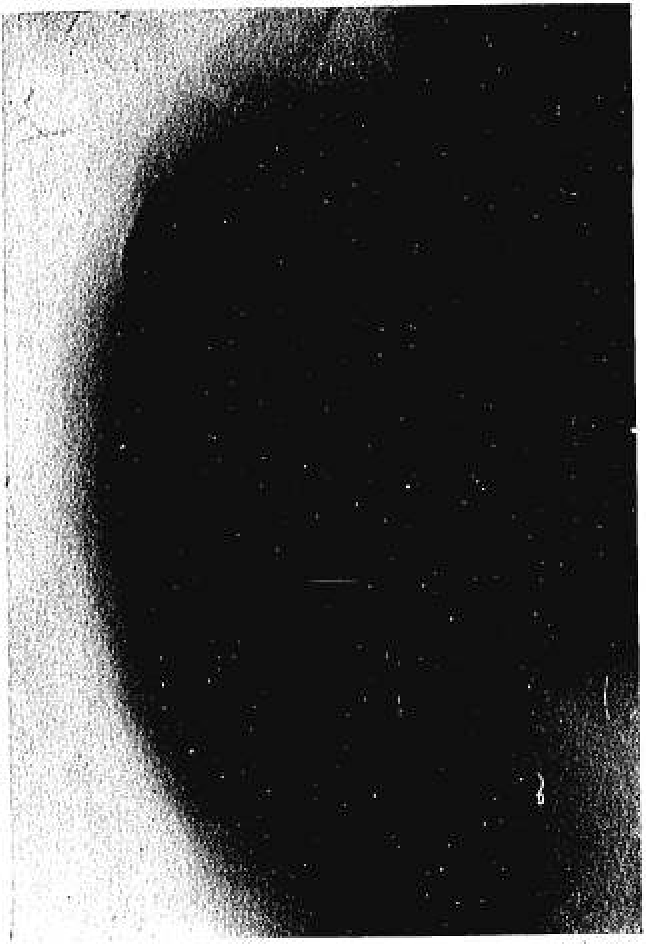

FIG. 1.—Skiagraph taken before operation.

are considered. A diagnostic incision, however, seemed justifiable and was demanded.

Removal of the arm with the scapula and the outer two-thirds of the clavicle, interscapulothoracic amputation, was done under ether anæsthesia on November 5.

The important points in this operation are, the control of the hæmorrhage and the prevention of shock from dividing the great nerve-trunks. Death from this operation will usually be due to shock, with or without hæmorrhage. It was shown in this case that shock could be prevented entirely by controlling hæmorrhage, so that practically no blood was lost, and by adopting the method of Crile and Cushing, of injecting a weak solution of cocaine into the large nerve-trunks of the brachial plexus before dividing them. It is known that one of the great factors in causing shock from surgical operations is the division of the great nerve-trunks, the brachial plexus, the sciatic and anterior crural nerves. Crile * has shown by his experiments and practical work, that if, before dividing the nerves, a few drops of a weak cocaine solution are injected directly into each nerve-trunk, the division of the nerves has no perceptible effect on the pulse-rate or volume. In this same connection Crile has shown that in operations upon the larynx painting the internal surface of the larynx with a solution of cocaine will prevent those unfortunate cases of fatal failure of respiration due to interference with the recurrent laryngeal nerve-fibres.

Cushing (ANNALS OF SURGERY, 1902, Vol. xxxvi, page 321) has written at length on prevention of shock in major amputations by the use of this method, and reported two cases of interscapulothoracic amputation in which he had used it with apparent success. The writer has had little experience with this use of cocaine aside from this case; it has been used twice by him in amputations of the thigh in cases in which moderate shock was present before the operation. In both cases the amount of shock was not added to by the operation. Lund

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* Problems relating to Surgical Operations, Philadelphia, 1891.

(*Boston Medical and Surgical Journal*, April 16, 1903) has reported a case of this form of amputation for sarcoma of the humerus in which he followed out this method of Crile's, and in his opinion it was very effective. A careful search of the surgical records at the Massachusetts General Hospital shows that since 1870 this operation has been performed in but four cases in addition to the case described by the writer. In none of the cases is it recorded that this method was adopted. In one case of the four there is no mention in the records of shock; in the other three cases shock was profound. In one case, which died within a few hours after the operation, it may be assumed with fairness that the amount of hæmorrhage, because of the failure to secure the subclavian vessels, was sufficient to have caused the shock; in another case the patient was in very bad general condition from prolonged suppuration. The fourth case was apparently a very favorable one for operation; the hæmorrhage was well controlled, and there was apparently no reason for the condition of extreme shock which supervened towards the end of the operation requiring much stimulation and oxygen, except for the division of the nerve-trunks. It is noteworthy that in this case the trunks of the brachial plexus were cut twice; that is to say, after dividing the nerves the first time it seemed wise to the surgeon to cut them off again higher up.

The difficult part of this operation, and the part which took the longest time, was the ligating of the subclavian artery and vein preliminary to removing the extremity. It was made easier because the subject was not large and fat, nor was there any infiltration of the supraclavicular region with disease, so that the dissection was through normal tissues at this point. The method of cutting through the clavicle, leaving the inner third, was chosen because no reason was seen for adopting the more dangerous method of disarticulating the clavicle at the sternal joint. The middle third of the clavicle was divided subperiosteally, the underlying periosteum and subclavius muscle divided and pulled aside, and the subclavian vessels disclosed by careful dissection. It was found that much care was necessary in dissecting down upon the artery, which was covered by

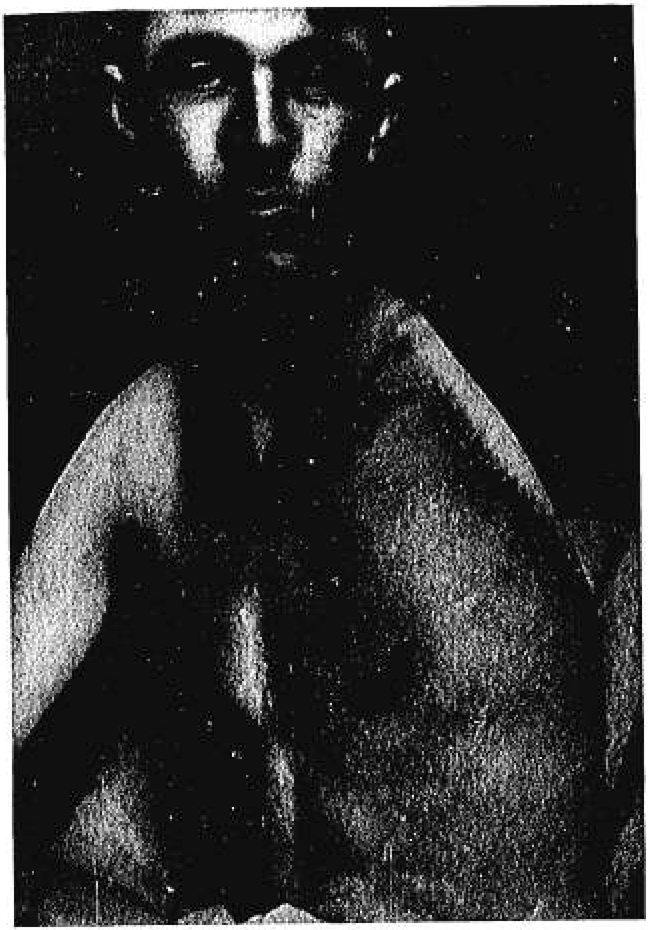

FIG. 2.—Photograph of the patient taken eight days after operation.

the subclavian and many smaller veins. The artery was ligated first with two strong silk ligatures and was divided between the ligatures, after which a third ligature was applied to the proximal end for increased safety. The arm was then elevated to empty it of blood, and then the vein was tied and divided. After ligating the vessels, the formation of the skin flaps and the division of the muscles were comparatively easy. The anterior and posterior skin incisions were joined at the root of the neck and at the bottom of the axilla. The pectoral muscles were rapidly divided, the trunks of the brachial plexus were injected with cocaine (Schleich's solution), and divided with scissors, after which the muscles attaching the scapula to the trunk were cut as quickly as possible. The suprascapular and posterior scapular vessels, the only blood-vessels of any importance to look out for after the subclavian had been secured, were readily seen and clamped. The skin flaps came together easily, were sewed with interrupted silkworm-gut stitches, and a small rubber tissue drain was placed in the lowest angle of the incision.

The patient was under ether one hour and fifteen minutes, thirty-five minutes of this time was consumed in the resection of the clavicle and ligation of the vessels. There was no shock whatever from this operation; the pulse remained at 80 throughout and did not change in volume at any time. The evening of the day after the operation the temperature rose to 100° F., but became normal the next day. The rubber tissue drain was removed in forty-eight hours. The patient made a complete and uneventful recovery, and on the fifth day was up walking about the ward. (Fig. 2.) The pathological report on the specimen was made by Dr. W. F. Whitney, and is as follows: "The left arm with scapula and clavicle removed together. At the upper part of the humerus, just below the head, was a new growth about eight centimetres in greatest extent, three centimetres in thickness, of a fusiform character, embracing the shaft and almost encircling it. Upon section it was grayish, homogeneous, with marked calcification and erosion of the cortical portion of the bone, and apparent extension into the medullary cavity, but without any destruction of the cortex. The circumflex vein was filled with a thrombus composed of new growth, which extended as far as its union with the axillary vein, into which it slightly projected. A number of other small veins in the immediate vicinity were also thrombosed. There were numerous large, soft, axillary lymph nodes. Microscopic examination of the growth showed it to be composed of large round cells of irregular shape and size, mixed with many multinucleated ones. In places the tissue was extensively calcified. *Giant-cell sarcoma of periosteal origin with extension into the veins.* The lymph nodes showed simple hypertrophy, especially of the endothelial elements."

Before the operation, it was thought that this was a specially favorable case, inasmuch as the limited duration of the growth and its confinement to the humerus and deltoid muscle fostered the hope that recurrence would be long delayed; after finding the sarcomatous thrombi in the veins, however, an early return was feared. Eight months later the patient entered the medical wards of the hospital suffering from pleurisy with bloody fluid, beyond a doubt of malignant origin. The history as given in the medical records is as follows:

" May 31, 1904, Re-entry. P. I. Three months ago first had pain in the back; this disappeared but three weeks ago; he began to have a cough with white and at times bloody sputum, and severe pain in lower right chest. Pain worse on deep breathing and on coughing. Tapped three days ago and three and one-half quarts of bloody fluid removed, after which cough and pain became worse. Appetite poor, sleeps well, bowels constipated. Has lost but little strength, chief complaint is pain in chest.

" P. E. Well developed and fairly well nourished. Pupils equal and react. Tongue moist, heavy white coat. Teeth.—Upper false, remainder in fair condition. Pharynx somewhat injected. Glands palpable in right axilla. Amputation of left arm and shoulder with an irregular seven-inch scar. Heart.—Impulse and dulness correspond in fourth space half-inch outside nipple line. Right border half-inch to right of sternum. Action regular, sounds of good quality. No murmurs. Systolic thrill palpable at apex. Pulse regular, of good volume and tension, artery not palpable. Lungs.—Dulness, becoming flatness, with diminished vocal and tactile fremitus and breathing as high as the sixth rib

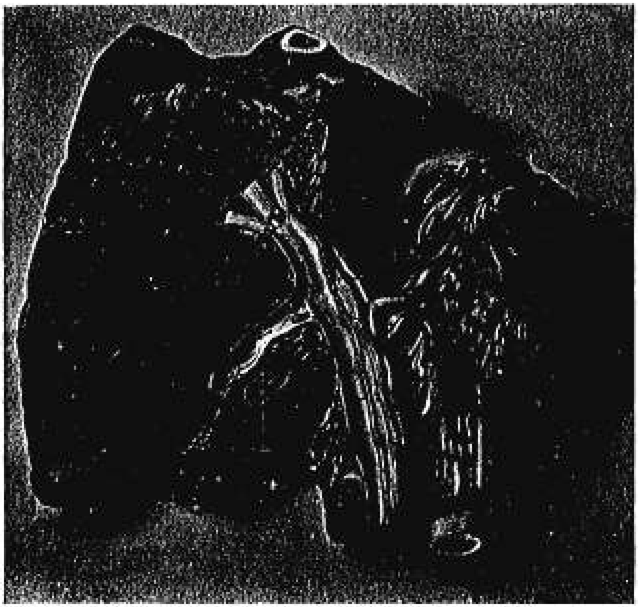

FIG. 3.—Picture of the specimen made soon after the amputation. Note the relation of the new growth to the scapula, the great blood-vessels, and the brachial plexus; note the sarcomatous thrombi in the subscapular vein.

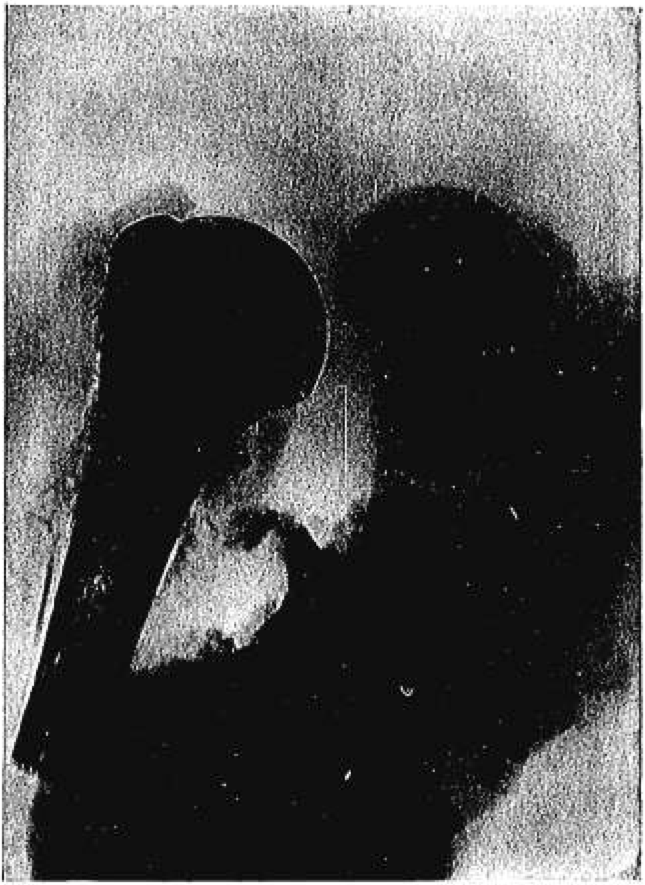

FIG. 4.—X-ray photograph of the specimen; the humerus has been sawed vertically; note the different stages of the periosteal growth, also the invasion of the cortical substance.

front and back on the right with friction rubs and coarse râles above. Abdomen full, muscles held somewhat rigidly, tympanitic throughout except in epigastrium and right hypochondrium, where there is dulness; no masses or tenderness. Liver-dulness, upper border not made out, lower border one and one-half inches below costal margin in nipple line. Spleen not palpable. Reflexes present and normal. External genitals normal. No œdema. Temperature, 99.6° F.; pulse, 112; respiration, 28.

Hb.—80 per cent. Whites, 19,500.
Urine-n-ac-1028-alb=0 (Sed. Few fat cells. Occ. squamous and
cl-n U-3.28 per cent b.s.d.=0) large round cells.

"June 1. This A.M. complained of pain in left chest; on examination a marked friction rub was felt and heard in lower left chest in the side.

"June 5. Fluid in right chest is diminishing; friction rub in left side is nearly gone, and signs of fluid are disappearing. Feels and looks better.

"June 8. Friction rub disappeared. Feeling better every day.

"June 12. Right chest tapped this morning twice but no blood or fluid obtained. General condition unchanged.

"June 15. Two days ago developed a dry pleurisy in cardiac region; very painful. No rise in respiration or temperature. To-day it has nearly disappeared and patient feels very well.

Hb.—80 per cent. Whites, 9400.

"June 19. Anxious to go home. No more pleurisy or pain in chest. Discharged much relieved."

It is noteworthy that in spite of the widespread pleural involvement as evidenced by varying areas of pain, friction rubs, and abundant hæmorrhagic exudate, the patient improved greatly while in the hospital, and left comparatively free from pain and with no fluid in the chest. He was seen by the writer at this time, and was in good flesh, looking about as well as when he was operated upon. For over six months after the operation he stated that he had been, in his opinion, perfectly well and entirely free from pain.

The patient died from recurrence of the pleurisy and suspicious cerebral symptoms early in July, 1904, nine months after the operation.

It is disappointing to the surgeon to have in an apparently favorable case such a rapid recurrence with fatal termination. Such an outcome emphasizes the fact that no prognosis in regard to sarcoma can be made. Unfortunately, in the majority of cases operated upon, the disease recurs within twelve months, not locally for the most part, but in some more or less remote region. For seven months the young man was free from pain and mental worry, and was to all intents and purposes well; whereas, before the operation his suffering was very great both in mind and body, and the progress of the growth was rapid; this is sufficient justification for the operation.

Attention is again called to the malignant thrombi that were found in the circumflex and subscapular veins upon examination of the specimen; these can be seen in the illustration of the specimen. (Fig. 3.) At the time it was suspected that the presence of these thrombi meant that it was possible and probable that metastasis had already taken place into the venous system beyond, and, as was suggested above, it is not unsound reasoning to assume that the exploratory incision for diagnosis caused their formation.

The operation of interscapulothoracic amputation is considered to be one of the most radical of procedures. It should be the method adopted in most cases of malignant disease of the humerus, especially when the disease involves the tissues of the shoulder over the head of the bone. It may have to be done occasionally for malignant disease of the axilla, when the axillary vessels cannot be ligated without destroying the vitality of the upper arm; very rarely a surgeon will be called upon to perform this amputation in extensive injuries of the upper arm and scapula. Lund, of Boston, has had one traumatic case, which, however, did not survive the operation. It is rare that cases subjected to such severe traumatism are in sufficiently good condition to stand this operation.

Statistics cannot furnish an accurate estimate of the mortality of this operation when done for malignant disease of the humerus. The character and size of the growth, the age and resistance of the patient, and the method of operating are factors which vary within wide limits. If the patient is in sound physical condition in other respects, and the growth is limited to the shoulder, with little infiltration into the tissues at the base of the neck, and if in the operation proper technical attention is given to the control of the hæmorrhage and prevention of shock, as described above, it is rational to feel that in the great majority of cases this operation can be done with safety, probably with just as much safety as amputation of the upper extremity at the shoulder-joint.

The control of the hæmorrhage is an all-important factor in this operation. The method which most speedily and safely exposes the third portion of the subclavian artery and vein always should be adopted. The operation as outlined by the writer is essentially the operation described by Berger (L'Amputation du Membre supérieur, etc., Paris, 1887). It is possible to enumerate as many as eight or nine different methods of controlling the hæmorrhage, as has been done by Le Conte (ANNALS OF SURGERY, 1899, Vol. xxx, page 260), several of them depending upon compression of the subclavian vessels with or without resection of the clavicle. Most of these are uncertain and unsafe. There are only three surgical ways to efficiently control the hæmorrhage, and of these three ways one, in the vast majority of cases, always is to be preferred. The artery and vein may be ligated without preliminary resection of the clavicle, after subperiosteal resection of the middle portion, or after disarticulation of the clavicle from the sternum, with removal of the entire bone. Le Conte has written at some length advocating the removal of the whole clavicle previous to securing the blood-vessels. His reasons for this are that it is needed to give the best exposure, and decreases the accidents of ligation. He thinks the method is quicker and easier than resection. The writer can see no reason for choosing this method, except in those exceptionally rare cases of large tumors with extensive encroachment upon the tissues at the base of the neck, in which it is doubtful whether by resecting the middle third of the clavicle enough room can be obtained to safely expose the vessels, or in cases in which the clavicle is so involved in the disease that it may be more surgical to remove the whole bone. Whenever malignant disease has so extensively involved the tissues at the base of the neck and the bony substance of the clavicle as to require excision of the whole clavicle, it may be questioned with good reason whether any operation is advisable. Disarticulation of the clavicle at the sternal end must invariably be a more dangerous procedure than resection at the junction of the inner and middle thirds. The risk of wounding the innominate vein or the pleura is considerable; the attachments of the sternomastoid muscle will be weakened, and the deep fascia of the neck opened in all probability. In the writer's opinion, the method of choice in all cases in which operation is advisable is the subperiosteal resection of the middle third of the clavicle preliminary to ligation of the vessels and the ligation of the subclavian artery in its third portion before ligating the vein. This method will give room enough. In large, heavily muscled and fat individuals it may be necessary to divide transversely some fibres of the pectoral muscles. Lund, in his article referred to above, reports that this procedure was adopted by him with great advantage. If this is done, there cannot fail to be room enough for a safe and fairly rapid dissection, if the case is at all an operable one.

Among the cases at the Massachusetts General Hospital there has been found one case of advanced malignant disease, with a duration of many months, in which the extension to the soft parts of the base of the neck was marked. This case was operated upon; but upon resection of the middle third of the clavicle the surgeon was unable to find the subclavian artery, or to feel its pulsation, thereupon he adopted the method of making a posterior incision, turning up and forward the scapula and arm and clamping the axillary artery and vein at the very last of the operation under the anterior flap; this patient survived the operation but a few hours. In this case it may be questioned whether resection of the whole clavicle was not indicated; and it is in such cases as this, in the opinion of the writer, provided operation is attempted at all, that disarticulation of the clavicle is necessary.

In one of the hospital cases, ligation of the subclavian vessels was done before resection of the clavicle; in the rest of the cases resection of the middle third was the method of choice. There is nothing to recommend the method of ligation of the subclavian vessels before resection of the bone. The field in which dissection is done is limited; after removal of the middle third of the bone, it must be easier and safer and can be done much more rapidly.